

We claim:

- 1 1. A method comprising:
 - 2 a) depositing a multilayer structure on a semiconductor substrate, the
3 multilayer structure including a first layer comprising titanium and in contact with the
4 substrate, a second layer overlying the first layer and comprising an element selected from
5 the group consisting of cobalt, tungsten, tantalum, and molybdenum, and a third layer
6 comprising titanium overlying the second layer, in which the amount of the element does
7 not exceed 20 atomic percent of the total amount of the element and titanium present in
8 the multilayer structure; and
 - 9 b) annealing the substrate and the structure in a nitrogen-containing
10 atmosphere at about 500°C to about 700°C.
- 1 2. The method of claim 1 in which the multilayer structure is about 9
2 nm to about 170 nm thick.
- 1 3. The method of claim 2 in which the amount of the element present
2 in the structure is about 1 to about 10 atomic percent of the total amount of the element
3 and titanium present in the structure.
- 1 4. The method of claim 3 in which the structure is about 9 nm to
2 about 20 nm thick and the amount of the element present in the structure is about 3 to
3 about 7 atomic percent of the total amount of the element and titanium present in the
4 structure.
- 1 5. The method of claim 4 in which the structure is about 16 nm thick,
2 the amount of the element present in the structure is about 5 atomic percent of the total
3 amount of the element and titanium present in the structure, and the annealing is
4 conducted at about 600°C for about 0.5 to 2 hours.

- 1 6. The method of claim 5 in which the element is cobalt.
- 1 7. The method of claim 5 in which the element is tungsten.
- 1 8. The method of claim 5 in which the element is tantalum.
- 1 9. The method of claim 5 in which the element is molybdenum.
- 1 10. The method of claim 1 additionally comprising, after step (b), the
2 step (c) of depositing a conductive material on the structure.
- 1 11. The method of claim 10 in which the multilayer structure is about 9
2 nm to about 170 nm thick.
- 1 12. The method of claim 11 in which the amount of the element present
2 in the structure is about 1 to about 10 atomic percent of the total amount of the element
3 and titanium present in the structure.
- 1 13. The method of claim 12 in which the depositing step is performed
2 using a vacuum deposition technique.
- 1 14. The method of claim 10 in which the structure is about 9 nm to
2 about 20 nm thick and the amount of the element present in the structure is about 3 to
3 about 7 atomic percent of the total amount of the element and titanium present in the
4 structure.
- 1 15. The method of claim 10 in which the conductive material is
2 tungsten.
- 1 16. The method of claim 15 in which the structure is about 9 nm to
2 about 170 nm thick and the amount of the element present in the structure is about 1 to
3 about 10 atomic percent of the total amount of the element and titanium present in the
4 structure.

1 17. The method of claim 16 in which the structure is about 5 nm to
2 about 20 nm thick and the amount of the element present in the structure is about 3 to
3 about 7 atomic percent of the total amount of the element and titanium present in the
4 structure.

1 18. The method of claim 17 in which the structure is about 16 nm thick,
2 the amount of the element present in the structure is about 5 atomic percent of the total
3 amount of the element and titanium present in the structure, and the annealing is
4 conducted at about 600°C for about 0.5 to 2 hours.

1 19. A contact prepared by the method of claim 10.

1 20. The contact of claim 19 in which the conductive material is
2 tungsten.

1 21. The contact of claim 20 in which the multilayer structure is about 9
2 nm to about 170 nm thick and the amount of the element present in the structure is about
3 1 to about 10 atomic percent of the total amount of the element and titanium present in
4 the structure.

1 22. The contact of claim 21 in which the structure is about 16 nm thick;
2 the amount of the element present in the structure is about 5 atomic percent of the total
3 amount of the element and titanium present in the structure; and the annealing is
4 conducted at about 600°C for about 0.5 to 2 hours.

1 23. The contact of claim 22 in which the element is cobalt.

1 24. The contact of claim 22 in which the element is tungsten.

1 25. The contact of claim 22 in which the element is tantalum.

1 26. The contact of claim 22 in which the element is molybdenum.

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